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AIRBORNE FULFILLMENT CENTER UTILIZING UNMANNED AERIAL VEHICLES FOR ITEM DELIVERY

BACKGROUND

Many companies package items and/or groups of items together for a variety of purposes, such as e-commerce and mail-order companies that package items (e.g., books, CDs, apparel, food, etc.) to be shipped to fulfill orders from users. Retailers, wholesalers, and other product distributors (which may collectively be referred to as distributors) typically maintain an inventory of various items that may be ordered by users. A ground-based building, such as a materials handling facility, may maintain and process and ship such inventory.

Typically ordered items are packed in shipping packages (e.g., corrugated boxes) and shipped to the user's residence or place of business. Physical delivery of items to user specified locations has improved dramatically over the years, with some retailers offering next day delivery of ordered items. The final or last mile delivery of physical items to a user specified location is traditionally accomplished using a human controlled truck, bicycle, cart, etc. For example, a user may order an item for delivery to their home. The item may be picked from a ground-based materials handling facility, packed and shipped to the user for final delivery by a shipping carrier. The shipping carrier will load the item onto a truck that is driven by a human to the final delivery location and the human driver, or another human companion with the driver, will retrieve the item from the truck and complete the delivery to the destination. For example, the human may hand the item to a recipient, place the item on the user's porch, store the item in a post office box, etc.

BRIEF DESCRIPTION OF THE DRAWINGS

The detailed description is described with reference to the accompanying figures. In the figures, the left-most digit(s) of a reference number identifies the figure in which the reference number first appears. The use of the same reference numbers in different figures indicates similar or identical components or features.

FIG. 1 is a block diagram of a delivery environment that includes an airborne fulfillment center, according to an implementation.

FIG. 2 is a diagram of an unmanned aerial vehicle network, according to an implementation.

FIG. 3 is a diagram illustrating an unmanned aerial vehicle delivery process that utilizes an airborne fulfillment center, according to an implementation.

FIG. 4 is an illustration of an airborne fulfillment center and a shuttle docked with the airborne fulfillment center, according to an implementation.

FIG. 5 is an illustration of a shuttle, according to an implementation.

FIG. 6 is an illustration of a top-down view of an unmanned aerial vehicle, according to an implementation.

FIG. 7 is another illustration of an unmanned aerial vehicle, according to an implementation.

FIG. 8 is a flow diagram of an example order delivery selection process, according to an implementation.

FIG. 9 is a flow diagram of an example unmanned aerial vehicle item delivery process, according to an implementation.

FIG. 10 is a flow diagram of an example airborne fulfillment center advertising and delivery process, according to an implementation.

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FIG. 11 is a flow diagram of an example shuttle process, according to an implementation.

FIG. 12 is a block diagram of an example unmanned aerial vehicle control system, according to an implementation.

FIG. 13 is a block diagram of an illustrative implementation of a server system that may be used with various implementations.

While implementations are described herein by way of example, those skilled in the art will recognize that the implementations are not limited to the examples or drawings described. It should be understood that the drawings and detailed description thereto are not intended to limit implementations to the particular form disclosed but, on the contrary, the intention is to cover all modifications, equivalents and alternatives falling within the spirit and scope as defined by the appended claims. As used throughout this application, the word "may" is used in a permissive sense (i.e., meaning having the potential to), rather than the mandatory sense (i.e., meaning must). Similarly, the words "include," "including," and "includes" mean including, but not limited to. Additionally, as used herein, the term "coupled" may refer to two or more components connected together, whether that connection is permanent (e.g., welded) or temporary (e.g., bolted), direct or indirect (i.e., through an intermediary), mechanical, chemical, optical, or electrical. Furthermore, as used herein, "horizontal" flight refers to flight traveling in a direction substantially parallel to the ground (i.e., sea level), and that "vertical" flight refers to flight traveling substantially radially outward from the earth's center. It should be understood by those having ordinary skill that trajectories may include components of both "horizontal" and "vertical" flight vectors.

DETAILED DESCRIPTION

This disclosure describes systems and methods for utilizing an aerial fulfillment center ("AFC") and unmanned aerial vehicles ("UAV") to facilitate delivery of ordered items to users. An AFC may be a fulfillment center that is supported by and/or incorporated into an airship. An airship, or dirigible, is a type of aerostat or lighter-than-air aircraft which can navigate through the air under its own power. Airships gain their lift from gas that is less dense than the surrounding air, such as helium or hot air.

An AFC may be positioned at an altitude above a metropolitan area and be designed to maintain an inventory of items that may be purchased by a user and delivered to the user by a UAV that is deployed from the AFC. For example, a user may browse an e-commerce website and place an order for an item that is in the inventory of the AFC. Upon placing the order for the item, fulfillment instructions may be sent to the AFC and a UAV within the AFC may engage the item for delivery to the user. When the UAV departs the AFC, it may descend from the high altitude of the AFC using little or no power other than to guide the UAV towards its delivery destination and/or to stabilize the UAV as it descends.

When the UAV approaches earth, the UAV may engage the motors of the UAV and utilize the lifting forces generated by the motors and corresponding propellers of the UAV to slow the descent of the UAV and to complete navigation to the user specified delivery location. When the UAV reaches the delivery location, it may disengage the ordered item and complete the delivery.

After completing an item delivery, the UAV may navigate to a nearby ground based materials handling facility or a shuttle replenishment location. Because of the high altitude of the AFC, navigation by a UAV back to the AFC may not be feasible, or an efficient use of power. Accordingly, a replen-